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A full C-band high brightness RF injector for future EuPRAXIA@SPARC_LAB upgrade

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C-band technology holds the potential to generate a high-energy, high-brightness electron beam by elevating the peak field of both the cathode and cavity within the machine. This proposed injector offers a promising avenue for achieving a high repetition rate, facilitating kHz operation. The conceptualization of this injector draws inspiration from the EuPRAXIA@SPARC_LAB S-band injector, wherein the original gun is replaced with a 2.6-cell C-band RF gun. The entire beamline is proportionally scaled, reducing longitudinal lengths by a factor of 2 while doubling electric and magnetic fields. Operating with brief RF pulses, the 2.6-cell C-band RF gun effectively mitigates breakdown rates and power dissipation. By capitalizing on higher peak fields and applying established scaling laws to reduce laser spot size and duration, it becomes feasible to minimize both cathode and space charge emittance. The incorporation of a complete C-band injector is anticipated within the framework of the X-band Linacs for the EuPRAXIA@SPARC_LAB design study, aiming to produce ultra-high-quality beams primed for applications such as light production or plasma acceleration.

Footnotes

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